

AMENDMENTS TO THE CLAIMS

1 1. (Currently Amended) A laser and optical amplifier device comprising:
2 a waveguide having a plurality of layers of semiconductor material with different
3 optical indices, the waveguide including a first heightened region in a first of said layers, the
4 first heightened region forming a channel along a longitudinal axis within which a lowest order
5 spatial mode in both lateral and transverse directions is supported;
6 an active region within a second layer near the first heightened region of the waveguide
7 that is pumped to provide gain for said lowest order spatial mode in said waveguide; and
8 first and second lateral regions, extending parallel to and on each side of said first
9 heightened region along the longitudinal axis, into which all higher order spatial modes extend
10 laterally and are suppressed, wherein the cross-sectional dimensions of the lowest order spatial
11 mode are at least several times larger in both the transverse and lateral directions than the
12 optical wavelength inside ~~the~~ a dielectric medium of the waveguide.

1 2. (Original) The device of claim 1 further comprising second and third heightened
2 regions, which extend parallel to and are separated from said first heightened region along the
3 longitudinal axis, and include absorptive regions to provide loss for higher order spatial
4 modes.

1 3. (Original) The device of claim 1, wherein loss in said first and second lateral
2 regions is generated by bombardment of all or certain layers with protons or other damage-
3 inducing ions to provide additional loss for higher order spatial modes.

1 4. (Original) The device of claim 1, wherein loss in said first and second lateral
2 regions is generated by roughening the sidewalls of the device to further suppress higher order

3 spatial modes.

1 5. (Original) The device of claim 1, wherein loss in said first and second lateral
2 regions is generated by doping said regions to provide large free-carrier absorption which adds
3 additional loss for higher order spatial modes.

1 6. (Original) The device of claim 1, wherein the cross-sectional dimensions of the
2 lowest order spatial mode are at least an order of magnitude larger than the optical wavelength
3 inside the dielectric medium of the waveguide.

1 7. (Original) The device of claim 2, wherein the cross-sectional dimensions of the
2 lowest order spatial mode are at least an order of magnitude larger than the optical wavelength
3 inside the dielectric medium of the waveguide.

1 8. (Original) The device of claim 1, wherein the contours of constant optical intensity
2 for the lowest order spatial mode supported within said waveguide are nearly circular.

1 9. (Original) The device of claim 1, wherein the contours of constant optical intensity
2 for the lowest order spatial mode supported within said waveguide have an approximately
3 elliptical shape with a small aspect ratio.

1 10. (Original) The device of claim 2, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular.

1 11. (Original) The device of claim 2, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide have an
3 approximately elliptical shape with a small aspect ratio.

1 12. (Original) The device of claim 2, wherein the first heightened region in the

2 waveguide is defined by a region between two parallel etched channels in said layers, and wherein
3 said second and third heightened regions are positioned outside the two parallel etched channels.

1 13. (Withdrawn) A laser and optical amplifier device comprising:

2 a dielectric structure having a waveguide defined therein which supports only a lowest
3 order spatial mode of propagation, the lowest order mode having a wavelength inside the
4 dielectric medium of the waveguide at least an order of magnitude smaller than a cross-
5 sectional dimension of said waveguide, and in which higher order spatial modes extend
6 laterally and are suppressed; and

7 a quantum well region formed in parallel and adjacent to the waveguide that generates
8 light that is confined to a lowest order mode of propagation by the waveguide.

1 14. (Withdrawn) The device of claim 13, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular.

1 15. (Withdrawn) The device of claim 13, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide have an
3 approximately elliptical shape with a small aspect ratio.

1 16. (Withdrawn) The device of claim 13, wherein the dielectric structure is a layer in
2 a semiconductor device.

1 17. (Withdrawn) The device of claim 13, wherein said waveguide is defined along a
2 longitudinal axis by a region between two parallel etched channels in the dielectric structure.

1 18. (Withdrawn) The device of claim 17, wherein regions in the dielectric structure
2 outside the two parallel etched channels along the longitudinal axis suppress high order modes.

1 19. (Original) A slab coupled optical waveguide laser comprising:
2 a waveguide having a plurality of layers of semiconductor material with different
3 optical indices, the waveguide including a first heightened region in a first of said layers, the
4 first heightened region forming a channel along a longitudinal axis within which a longitudinal
5 lowest order spatial mode in both lateral and transverse directions is supported;
6 an active region within a second layer near the first heightened region of the waveguide
7 that is pumped to provide gain for said lowest order spatial mode in said waveguide; and
8 first and second lateral regions, extending parallel to and on each side of said first heightened
9 region along the longitudinal axis, into which all higher order spatial modes extend laterally and
10 are suppressed.

1 20. (Withdrawn) A slab coupled optical waveguide laser comprising:
2 a dielectric structure having a waveguide defined therein which supports a lowest order spatial
3 mode of propagation, the lowest order mode having a wavelength inside the dielectric medium
4 of the waveguide at least an order of magnitude smaller than a cross-sectional dimension of
5 said waveguide, and in which higher order spatial modes extend laterally and are suppressed;
6 and
7 a quantum well region formed in parallel and adjacent to the waveguide that generates
8 light that is confined to a lowest order mode of propagation by the waveguide.

1 21. (Withdrawn) A laser and optical amplifier device comprising:
2 a dielectric structure having a waveguide defined therein which supports a lowest order
3 spatial mode of propagation, the lowest order mode having a wavelength inside the dielectric

4 medium of the waveguide at least several times smaller in both transverse directions than a
5 cross-sectional dimension of said waveguide, and in which higher order spatial modes extend
6 laterally and are suppressed; and

7 a quantum well region formed in parallel and adjacent to the waveguide that generates
8 light that is confined to a lowest order mode of propagation by the waveguide.

1 22. (Withdrawn) The device of claim 21, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular, having an approximately elliptical shape with a small aspect ratio.

1 23. (Withdrawn) The device of claim 21, wherein the dielectric structure is a layer in
2 a semiconductor device.

1 24. (Withdrawn) The device of claim 21, wherein said waveguide is defined along a
2 longitudinal axis by a region between two parallel etched channels in the dielectric structure.

1 25. (Withdrawn) The device of claim 24, wherein regions in the dielectric structure
2 outside the two parallel etched channels along the longitudinal axis suppress high order modes.

1 26. (Withdrawn) A slab coupled optical waveguide laser amplifier device comprising:
2 a dielectric structure having a waveguide defined therein which supports a lowest order spatial
3 mode of propagation, the lowest order mode having a wavelength inside the dielectric medium
4 of the waveguide at least several times smaller in both transverse directions than a cross-
5 sectional dimension of said waveguide; and

6 a quantum well region formed in parallel and adjacent to the waveguide that generates
7 light that is confined to a lowest order mode of propagation by the waveguide.

1 27. (Withdrawn) The device of claim 26, wherein the contours of constant optical
2 intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular, having an approximately elliptical shape with a small aspect ratio.

1 28. (Original) The device of claim 1, wherein a quantum well region provides gain.

1 29. (Original) The device of claim 1, wherein a quantum well region comprising one
2 or more quantum wells, barrier layers and bounding layers provides gain.

1 30. (Original) The device of claim 1, wherein a strained-layer quantum well region
2 provides gain.

1 31. (Original) The device of claim 1, wherein a strained-layer quantum well region
2 comprising one or more quantum wells, barrier layers and bounding layers provides gain.

1 32. (Original) The device of claim 1, wherein a region containing quantum dots or
2 quantum wires provides gain.

1 33. (Original) The device of claim 1 in which a region containing quantum dots or
2 quantum wires inside one or more quantum well layers provides gain.

1 34. (Original) The device of claim 1, wherein gain is provided by a region containing
2 one or more semiconductor layers.

1 35. (Original) The device of claim 2, wherein the regions between the first and
2 second heightened regions and between the first and third heightened regions are filled with
3 high resistivity material.

1 36. (Original) The device of claim 1, wherein plurality of layers of semiconductor

2 material with different optical indices are made of III-V compound semiconductors.

1 37. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor system on
3 an InP substrate.

1 38. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$ semiconductor system on
3 an InP substrate.

1 39. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a combination of the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$ and
3 $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on an InP substrate.

1 40. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_{1-x}\text{As}$ semiconductor system on a
3 GaAs substrate.

1 41. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$ semiconductor system on
3 a GaAs substrate.

1 42. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a combination of the $\text{Al}_x\text{Ga}_{1-x}\text{As}_z$ and $\text{In}_x\text{Ga}_{1-x}$
3 As semiconductor systems on a GaAs substrate.

1 43. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a the $\text{Ga}_y\text{In}_{1-y}\text{As}_z\text{P}_{1-z}$ semiconductor systems

3 on a GaAs substrate.

1 44. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{P}_{1-z}$ semiconductor
3 systems on a GaAs substrate.

1 45. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a combination of the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{P}_{1-z}$ and
3 $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on a GaAs substrate.

1 46. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$ semiconductor
3 system on an InP substrate.

1 47. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a combination of the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$
3 and $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on an InP substrate.

1 48. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$ semiconductor
3 system on a GaSb substrate.

1 49. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$ semiconductor
3 system on an InAs substrate.

1 50. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$ semiconductor system on

3 a GaN substrate.

1 51. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$ semiconductor system on
3 a sapphire substrate.

1 52. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$ semiconductor system on
3 a SiC substrate.

1 53. (Original) The device of claim 1, wherein plurality of layers of semiconductor
2 material with different optical indices are made in a the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{N}_{1-z}$ semiconductor
3 systems on a GaAs substrate.

1 54. (Original) The device of claim 1 wherein plurality of layers of semiconductor
2 material with different optical indices are made of II-VI compound semiconductors.

1 55. (Original) The device of claim 1 wherein plurality of layers of semiconductor
2 material with different optical indices are made of IV-VI compound semiconductors.

1 56. (Currently Amended) A laser and optical amplifier device comprising:
2 a waveguide having a first heightened region in a first layer, the first heightened region
3 forming a channel along a longitudinal axis within which a lowest order spatial mode in both
4 lateral and transverse directions is supported;
5 an active region, near the first heightened region of the waveguide, is pumped to
6 provide gain for said lowest order spatial mode in said waveguide; and

7 first and second lateral regions, extending parallel to and on each side of said first
8 heightened region along the longitudinal axis, into which all higher order spatial modes extend
9 laterally and are suppressed, wherein the cross-sectional dimensions of the lowest order spatial
10 mode are at least several times larger in both the transverse and lateral directions than the
11 optical wavelength inside ~~the~~ a dielectric medium of the waveguide.

1 57. (Previously Presented) The device of claim 56 further comprising second and
2 third heightened regions, which extend parallel to and are separated from said first heightened
3 region along the longitudinal axis, and include absorptive regions to provide loss for higher
4 order spatial modes.

1 58. (Previously Presented) The device of claim 56, wherein loss in said first and
2 second lateral regions is generated by bombardment of all or certain layers with protons or
3 other damage-inducing ions to provide additional loss for higher order spatial modes.

1 59. (Previously Presented) The device of claim 56, wherein loss in said first and
2 second lateral regions is generated by roughening the sidewalls of the device to further
3 suppress higher order spatial modes.

1 60. (Previously Presented) The device of claim 56, wherein loss in said first and
2 second lateral regions is generated by doping said regions to provide large free-carrier
3 absorption which adds additional loss for higher order spatial modes.

1 61. (Previously Presented) The device of claim 56, wherein the cross-sectional
2 dimensions of the lowest order spatial mode are at least an order of magnitude larger than the
3 optical wavelength inside the dielectric medium of the waveguide.

1 62. (Previously Presented) The device of claim 57, wherein the cross-sectional

2 dimensions of the lowest order spatial mode are at least an order of magnitude larger than the
3 optical wavelength inside the dielectric medium of the waveguide.

1 63. (Previously Presented) The device of claim 56, wherein the contours of constant
2 optical intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular.

1 64. (Previously Presented) The device of claim 56, wherein the contours of constant
2 optical intensity for the lowest order spatial mode supported within said waveguide have an
3 approximately elliptical shape with a small aspect ratio.

1 65. (Previously Presented) The device of claim 57, wherein the contours of constant
2 optical intensity for the lowest order spatial mode supported within said waveguide are nearly
3 circular.

1 66. (Previously Presented) The device of claim 57, wherein the contours of constant
2 optical intensity for the lowest order spatial mode supported within said waveguide have an
3 approximately elliptical shape with a small aspect ratio.

1 67. (Previously Presented) The device of claim 57, wherein the first heightened
2 region in the waveguide is defined by a region between two parallel etched channels in said
3 layers, and wherein said second and third heightened regions are positioned outside the two
4 parallel etched channels.

1 68. (Previously Presented) The device of claim 56, wherein a quantum well region
2 provides gain.

1 69. (Previously Presented) The device of claim 56, wherein a quantum well region

2 comprising one or more quantum wells, barrier layers and bounding layers provides gain.

1 70. (Previously Presented) The device of claim 56, wherein a strained-layer quantum
2 well region provides gain.

1 71. (Previously Presented) The device of claim 56, wherein a strained-layer quantum
2 well region comprising one or more quantum wells, barrier layers and bounding layers
3 provides gain.

1 72. (Previously Presented) The device of claim 56, wherein a region containing
2 quantum dots or quantum wires provides gain.

1 73. (Previously Presented) The device of claim 56 in which a region containing
2 quantum dots or quantum wires inside one or more quantum well layers provides gain.

1 74. (Previously Presented) The device of claim 56, wherein gain is provided by a
2 region containing one or more semiconductor layers.

1 75. (Previously Presented) The device of claim 57, wherein the regions between the
2 first and second heightened regions and between the first and third heightened regions are
3 filled with high resistivity material.

4 76. (Previously Presented) The device of claim 56, wherein said waveguide is
5 comprised of a plurality of layers of semiconductor material with different optical indices.

1 77. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made of III-V compound
3 semiconductors.

1 78. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$
3 semiconductor system on an InP substrate.

1 79. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$
3 semiconductor system on an InP substrate.

1 80. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a combination of the
3 $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$ and $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on an InP substrate.

1 81. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_{1-x}\text{As}$ semiconductor
3 system on a GaAs substrate.

1 82. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}$
3 semiconductor system on a GaAs substrate.

1 83. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a combination of the $\text{Al}_x\text{Ga}_{1-x}$
3 As_z and $\text{In}_x\text{Ga}_{1-x}\text{As}$ semiconductor systems on a GaAs substrate.

1 84. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a the $\text{Ga}_y\text{In}_{1-y}\text{As}_z\text{P}_{1-z}$
3 semiconductor systems on a GaAs substrate.

1 85. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{P}_{1-z}$
3 semiconductor systems on a GaAs substrate.

1 86. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a combination of the
3 $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{P}_{1-z}$ and $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on a GaAs substrate.

1 87. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$
3 semiconductor system on an InP substrate.

1 88. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a combination of the
3 $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$ and $\text{In}_x\text{Ga}_{1-x}\text{As}_y\text{P}_{1-y}$ semiconductor systems on an InP substrate.

1 89. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$
3 semiconductor system on a GaSb substrate.

1 90. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{Sb}_{1-z}$
3 semiconductor system on an InAs substrate.

1 91. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$
3 semiconductor system on a GaN substrate.

1 92. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$
3 semiconductor system on a sapphire substrate.

1 93. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}$
3 semiconductor system on a SiC substrate.

1 94. (Previously Presented) The device of claim 76, wherein said plurality of layers of
2 semiconductor material with different optical indices are made in a the $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{As}_z\text{N}_{1-z}$
3 semiconductor systems on a GaAs substrate.

1 95. (Previously Presented) The device of claim 76 wherein said plurality of layers of
2 semiconductor material with different optical indices are made of II-VI compound
3 semiconductors.

1 96. (Previously Presented) The device of claim 76 wherein said plurality of layers of
2 semiconductor material with different optical indices are made of IV-VI compound
3 semiconductors.